Driving Technological Surprise:

An Enduring Mission in a Changing World

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In case you thought
DARPA might scale back its far-out R&D ambitions
in light of impending defense budget cuts,
be advised:

the DoD's blue-sky researchers fear no fiscal cliff

(in fact, it has likely already developed
a self-assembling hypersonic vehicle
that will automatically scramjet the agency to safety
should any cliff, fiscal or otherwise,
be autonomously detected).

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DARPA Mission

Create and prevent strategic surprise

Anticipate, explore, and achieve
the concepts and technology on which
the Nation's future deterrent and defense capabilities depend

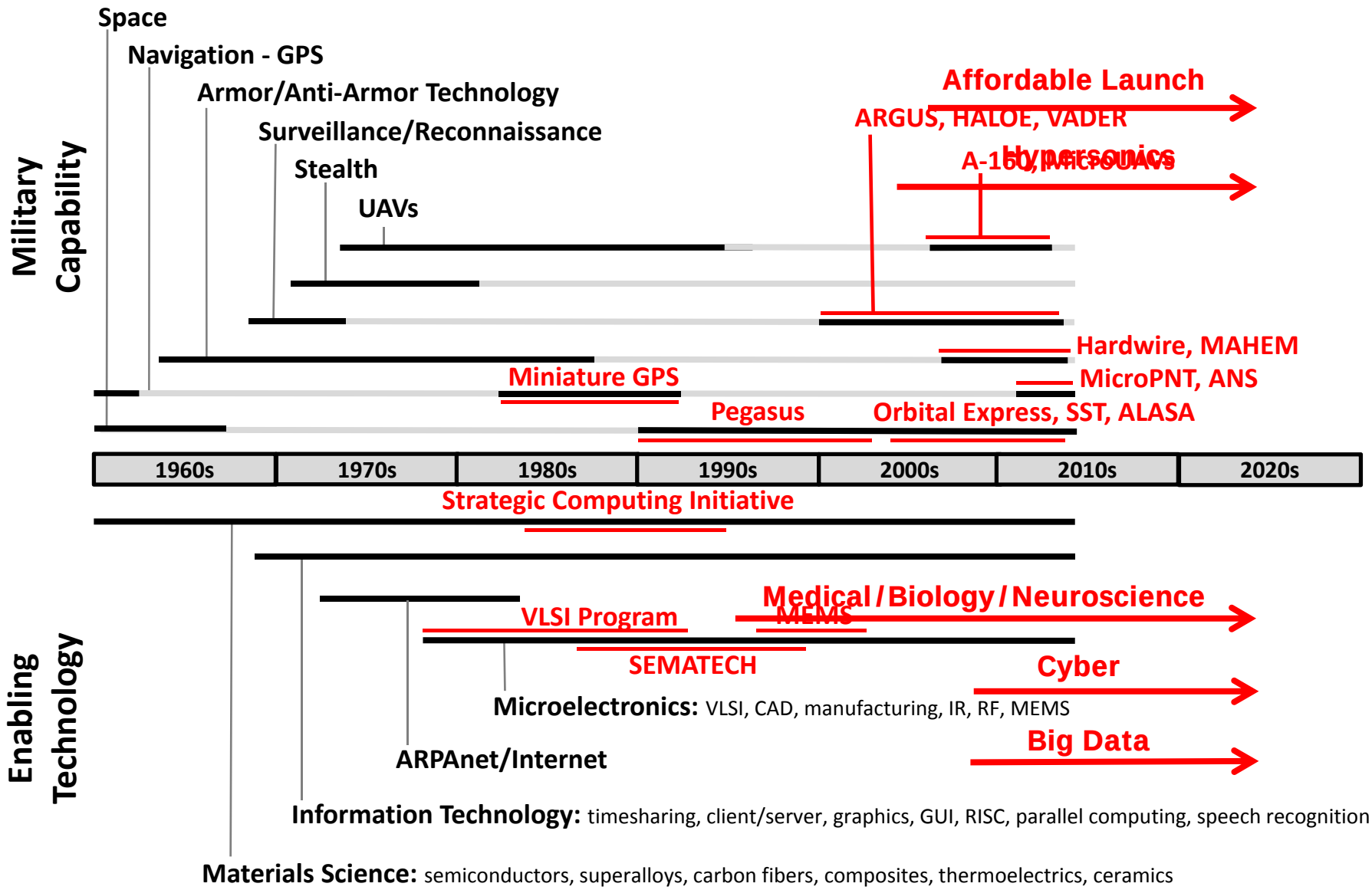
Three objectives:

Demonstrate breakthrough capabilities for national security

Catalyze a differentiated, highly capable U.S. technology base

Keep DARPA robust and vibrant

55 Years of Technological Surprise



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DARPA Today

- 210 government employees
  - 95 technical program managers
- $2.8B in FY2012
- 250 programs across 5 technology offices
- 2000 contracts and other agreements
  - Defense contractors large and small
  - Commercial companies large and small
  - Universities
  - DoD and other labs

DARPA Organizational Chart

Director
Arati Prabhakar

Deputy Director
Steven Walker

Dale C. Waters

Charles T. Wolf

ADAPTIVE EXECUTION

Mari Maeda

Geoffrey S.F. Ling

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Nils R. Sandell

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STRATEGIC TECHNOLOGY

Daniel M. Kaufman

Norman A. Whitaker

INFORMATION INNOVATION

Robert P. Colwell

David Shaver

MICROSYSTEMS TECHNOLOGY

Bradford C. Tousley

Pamela Melroy

TACTICAL TECHNOLOGY

Breakthrough National Security Capabilities

Today's Context

- Complex and unpredictable national security challenges
  - Actors: nation states, groups, individuals
  - Threats: kinetic, EW, cyber, nuclear, chemical, biological
- Constrained budgets to meet the Nation's security needs

Key Approaches

- Game-changing new systems technologies
- Layered, multi-technology war-fighting concepts
- Adaptable systems and solutions
- Innovation to invert the cost equation

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Cyber

Cyber defense

Today's patch-and-pray approach:

- Attacker has to find one flaw, defender has to find them all
- Perimeter defense – hard outside, soft inside
- Monoculture amplifies vulnerability

Future cybersecurity

- Formally provable, deeply integrated security properties
- Software randomized "under the hood" but consistent user interface
- Testable software properties and auditable supply chains

Cyber offense

Today's cyber tool development

- Artisan approach
- One-off without reliable or measurable effects
- Extraordinary authority required for use

Future tactical cyber warfare

- Integral to warfare - an alternative and augmentation to kinetics
- Automated, real time, scalable
- Predictable effects and BDA
- Rules of engagement with graduated authorities: 19-year-old to POTUS

Cost-Effective Space

Phoenix Program

- Cooperatively harvest and reuse valuable components from retired satellites in GEO
- Assemble on-orbit with satlets for new GEO satellites
- Lower cost and upgrade capability
- Opens the door for non-traditional space suppliers
- Encourages a responsible international ecosystem for spacecraft servicing

The Phoenix program is an unclassified program. DARPA is following the U.S. National Space Policy guidance to expand international cooperation in GEO.

Differentiated U.S. Technology Base

Today's Context

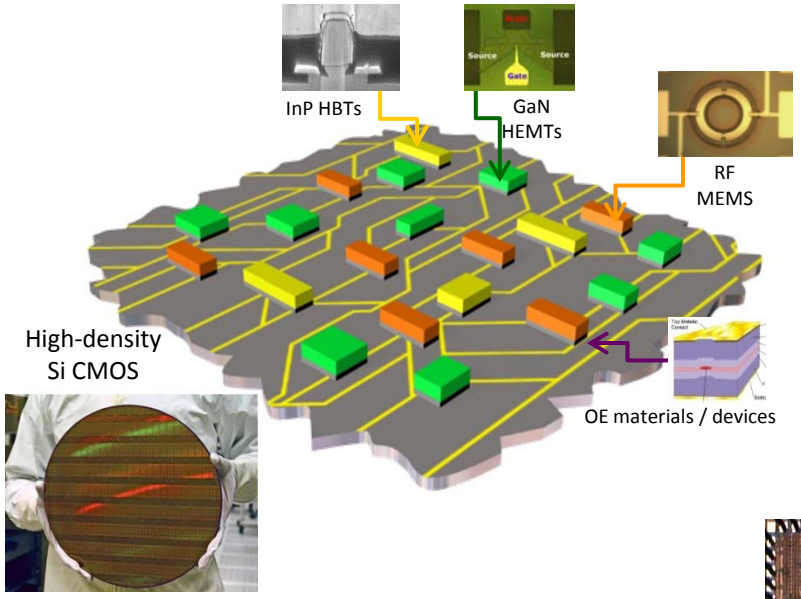
- Virtuous cycle between defense needs and commercial opportunities
- Broad and deep globalization
  - Design, production, supply chains
  - R&D, education and training

Key Approaches

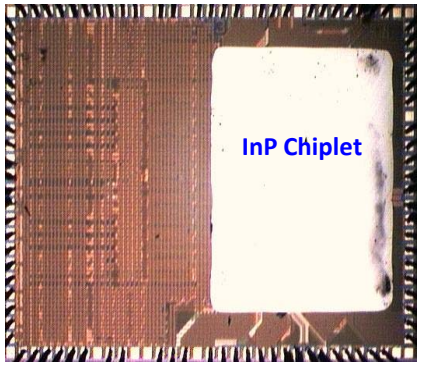
- Exploit and transcend commercially available technologies
- Catalyze new national technology capabilities
  - Explore technology possibilities from fertile research areas
  - Build radical technology infrastructure and communities
  - Demonstrate new capabilities

Heterogeneous Integration for Military Electronics

Diverse Accessible Heterogeneous Integration (DAHI) – Chiplet Integration



- Billions of transistors possible in commercial processes
- Thousands of boutique, military specific transistors integrated at the wafer scale



World record mixed InP and silicon DAC

Ex: InP Bicmos 13 bit signal generation at 1.33 GHz BW

- 12 dB better than InP only
- 30 dB better than Silicon

Brain-Machine Interface

Revolutionizing Prosthetics:
sophisticated prosthetic arms and direct brain control to take restoration of function to a new level

Societal Implications of New Technologies

- Leading edge of technology uncovers new societal questions
  - Ethical
  - Legal
  - Safety and security
  - Policy
- Two jobs for DARPA:
  - Explore new high-potential technology areas even in uncomfortable territory

    AND
  - Raise societal questions and engage others
- We work rigorously within the law and regulations
- For new areas, seek to engage experts with diverse viewpoints
- Technology solutions can sometimes be part of the answer

Keep DARPA Robust and Vibrant

Stellar program managers	Technical leadership	Effective support functions	Active engagement
Technology leaders	*Hire and empower PMs*	*Mission-focused productive environment*	*Broad, diverse technology community*
Adventurous spirit	*Define and manage portfolio*	*Legislated authorities*	*Services and agencies*
Conviction and drive to change the world			

DARPA Culture

Drive for off-scale impact | *Risk taking* | *Honor in public service*

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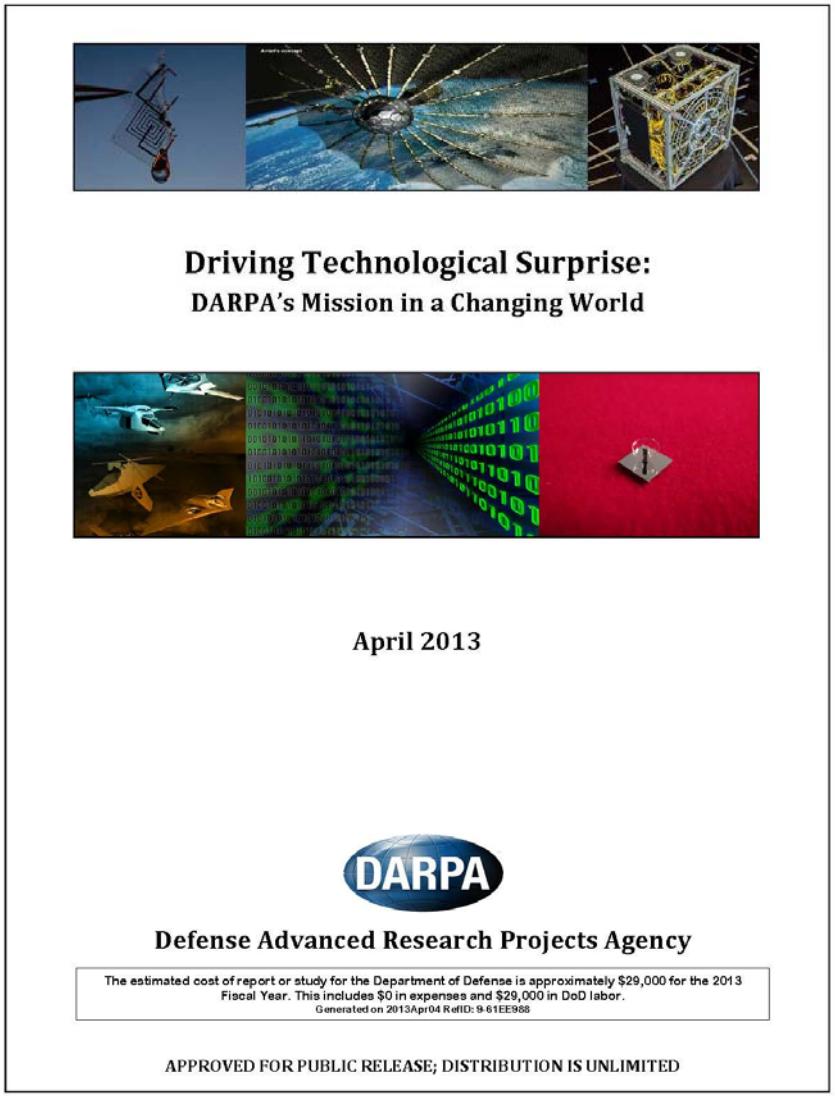

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Defense Advanced Research Projects Agency

The estimated cost of report or study for the Department of Defense is approximately $29,000 for the 2013 Fiscal Year. This includes $0 in expenses and $29,000 in DoD labor.
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